PATENT ABSTRACTS OF JAPAN

AB

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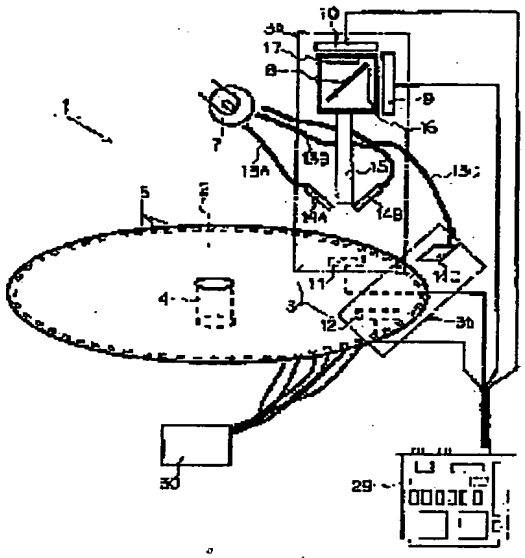
IKEDA MANABU

(54) RICE-PARTICLE-QUALITY DISCRIMINATING APPARATUS

(57) Abstract:

PROBLEM TO BE SOLVED: To provide the rice-particle-quality discriminating apparatus, wherein the constitution of an optical light-receiving means is simplified, the manufacturing cost becomes inexpensive and the fluctuation of the input voltage into an operating circuit is less.

SOLUTION: In a rice-particle-quality discriminating apparatus 1, the following parts are provided. A light source 7 projects light ray from the slant upper side to a sample grain particle moved from a sample picking hole 5. A dichroic mirror 8 classifies the amount of the vertical reflected light from the sample grain particle into the long-wavelength component and the short-wavelength component. Two photodetector 9 and 10 receive the amounts of lights having the respective classified wavelengths. A transmitted-light photodetector 11 receives the amount of the vertical transmitted light from the sample grain. The light ray is applied on one grain particle from the light source 7, from the slant upper side. A cracked-rice detecting photodetector 12, which receives the amount of the slant transmitted light from the sample grain particle, is provided.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] the circumferencial direction of a periphery edge -- sampling of a plurality [regular intervals] -- with the rotating disk which has a hole the aforementioned sampling -- with the light source which irradiates a beam of light for every grain of the sample grain of rice transported by the hole The detection section which detects the amount of transparency reflected lights of the aforementioned sample grain of rice obtained by irradiating with this light source, It is the grain-of-rice quality distinction equipment equipped with the judgment control section which determines the quality rank of the aforementioned sample grain of rice for the detecting signal inputted from this detection section as compared with a predetermined value. the aforementioned detection section the aforementioned sampling -- with the first irradiation section which irradiates the beam of light guided from the aforementioned light source to one grain of sample grain of rice transported by the hole from the two inclination upper parts The dichroic mirror which ****s the amount of perpendicular reflected lights from the aforementioned sample grain of rice for a long wavelength component (R) and a short wavelength component (G), respectively, While two photo detectors which receive the quantity of light of each wavelength which it ****ed, and the transmitted light photo detector which receives the amount (T) of perpendicular transmitted lights from the aforementioned sample grain of rice are prepared Grain-of-rice quality distinction equipment characterized by preparing the second irradiation section which irradiates the beam of light from the aforementioned light source from the inclination upper part to the aforementioned sample grain of rice, and the photo detector for a drum crack detection which receives the amount of method transmitted lights of slanting from the aforementioned sample grain obtained by irradiating by this second irradiation section.
[Claim 2] While the aforementioned judgment control section calculates transparency / reflective ratio {(R+G)/T} from the aforementioned amount (T) of perpendicular transmitted lights, and the diffuse reflection light by the sum of the aforementioned long wavelength component (R) and a short wavelength component (G) The total totaled product {(RxGxT)/(R+G+T)} of these 3 element is calculated from a long component (R) and a short wavelength component (G). the above -- a long wave -- the spectrum of a long component and a short wavelength component -- a ratio (R/G) -- calculating -- further -- the aforementioned amount (T) of perpendicular transmitted lights, and a long wave -- Grain-of-rice quality distinction equipment according to claim 1 used as the judgment data which determine the quality rank of the aforementioned sample grain of rice.
[Claim 3] It is what determines a quality rank with the judgment algorithm beforehand determined as the aforementioned judgment data. the aforementioned judgment algorithm the above -- a spectrum -- the values A and B of a ratio (R/G) -- a threshold -- carrying out -- ****** and blue -- with the first unripe field to mix It ****s to the second field which white ****, an opaque white grain, and a particle size regulation mix, and the third field which a damage grain and a tinction grain mix. White ****, the opaque white grain, and particle size regulation of unripe and the second aforementioned field are ****ed, respectively. the values C, D, and E of the aforementioned transparency / reflective ratio {(R+G)/T} -- a threshold -- carrying out -- ****** of the first aforementioned field, and blue -- Furthermore, grain-of-rice quality distinction equipment according to claim 2 which makes a threshold value F of the total product for the aforementioned total {(RxGxT)/(R+G+T)}, and comes to **** the damage grain and tinction grain of the third aforementioned field.

[Claim 4] The electrical signal HM which detects the trough of the optical intensity distribution " which connected drum crack wave detection equipment to the aforementioned photo detector for a drum crack detection, and irradiated the aforementioned sample grain of rice, While the electrical signal H1 which detects the high crest of the aforementioned optical intensity distribution, and the electrical signal H2 which detects the low crest of the aforementioned optical intensity distribution are inputted into the aforementioned judgment control section, this judgment control section Grain-of-rice quality distinction equipment according to claim 1, 2, or 3 which distinguishes a drum crack grain and a particle size regulation with the electrical signal HM of the aforementioned trough, and comes to distinguish a drum crack grain and an opaque white grain with aforementioned Yamabe's electrical signals H1 and H2.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention relates to the grain-of-rice quality distinction equipment which distinguishes the quality of a husked rice or a white rice.
[0002]
[Description of the Prior Art] Conventionally, what was indicated by for example, the Japanese Patent Publication No. 60382 [three to] official report and a Provisional-Publication-No. 28543 [64 to] official report is known as equipment which distinguishes the quality of a grain of rice. Inclination rotation of the disk which prepared the hole is carried out. sampling of plurality [invention / which was indicated by these official reports / edge / periphery] -- Light is irradiated for one grain of every husked rice of a sample husked rice, two waves of arbitrary quantity of lights and the amount of transmitted lights of two positions for one grain of every aforementioned husked rice are detected, respectively among the diffuse-transmission quantity of light and the diffuse reflection quantity of light, and diffuse reflection light, and judgment processing of the ratio of each aforementioned quantity of light is carried out that the quality for one grain of every aforementioned husked rice should be classified. And each aforementioned quantity of light is detected, by calculating and carrying out judgment processing of the ratio, the quality of a husked rice is classified more minutely and, moreover, the influence of the judgment precision on the sort by the grain shape can be eliminated.
[0003]
[Problem(s) to be Solved by the Invention] Since the above-mentioned conventional grain-of-rice quality distinction equipment classified the quality of a husked rice more minutely and eliminated the influence of the judgment precision on the sort by the grain shape, in order that it might receive the diffuse-transmission quantity of light, the diffuse reflection quantity of light, two waves of arbitrary quantity of lights in this diffuse reflection quantity of light, and the amount of transmitted lights of two positions for one grain of every husked rice, respectively, it needed to prepare the photo detector of a total of six kinds as an optical light-receiving means. Thereby, the optical light-receiving means had the fault from which a configuration becomes complicated and serves as manufacturing-cost quantity. Moreover, since many photo detectors were prepared, change of the input voltage to a judgment control section was large, and there was a possibility that dispersion might arise in the accuracy of measurement of a grain of rice.
[0004] this invention makes it a technical technical probrem that change of the input voltage to a judgment control section offers few grain-of-rice quality distinction equipment while it simplifies the configuration of an optical light-receiving means and makes a manufacturing cost cheap in view of the above-mentioned trouble.
[0005]
[Means for Solving the Problem] in order to solve the above-mentioned technical probrem -- this invention -- the circumferencial direction of a periphery edge -- sampling of a plurality [regular intervals] -- with the rotating disk which has a hole the aforementioned sampling -- with the light source which irradiates a beam of light for every grain of the sample grain of rice transported by the hole The detection section which detects the amount of transparency reflected lights of the aforementioned sample grain of rice obtained by irradiating with this light source, It is the grain-of-

rice quality distinction equipment equipped with the judgment control section which determines the quality rank of the aforementioned sample grain of rice for the detecting signal inputted from this detection section as compared with a predetermined value. the aforementioned detection section the aforementioned sampling -- with the first irradiation section which irradiates the beam of light guided from the aforementioned light source to one grain of sample grain of rice transported by the hole from the two inclination upper parts The dichroic mirror which ****s the amount of perpendicular reflected lights from the aforementioned sample grain of rice for a long wavelength component (R) and a short wavelength component (G), respectively, While two photo detectors which receive the quantity of light of each wavelength which it ****ed, and the transmitted light photo detector which receives the amount (T) of perpendicular transmitted lights from the aforementioned sample grain of rice are prepared The technical means of preparing the second irradiation section which irradiates the beam of light from the aforementioned light source from the inclination upper part to the aforementioned sample grain of rice, and the photo detector for a drum crack detection which receives the amount of method transmitted lights of slanting from the aforementioned sample grain obtained by irradiating by this second irradiation section were provided.

[0006] Moreover, while the aforementioned judgment control section calculates transparency / reflective ratio {(R+G)/T} from the aforementioned amount (T) of perpendicular transmitted lights, and the diffuse reflection light by the sum of the aforementioned long wavelength component (R) and a short wavelength component (G) The total totaled product {(RxGxT)/(R+G+T)} of these 3 element is calculated from a long component (R) and a short wavelength component (G). the above-- a long wave -- the spectrum of a long component and a short wavelength component -- a ratio (R/G) -- calculating -- further -- the aforementioned amount (T) of perpendicular transmitted lights, and a long wave -- It is good to consider as the judgment data which determine the quality rank of the aforementioned sample grain of rice.

[0007] It is what determines a quality rank with the judgment algorithm beforehand determined as the aforementioned judgment data. and the aforementioned judgment algorithm the above-- a spectrum -- the values A and B of a ratio (R/G) -- a threshold -- carrying out -- ****** and blue -- with the first unripe field to mix It ****s to the second field which white ****, an opaque white grain, and a particle size regulation mix, and the third field which a damage grain and a tinction grain mix. White ****, the opaque white grain, and particle size regulation of unripe and the second aforementioned field are ****ed, respectively. the values C, D, and E of the aforementioned transparency / reflective ratio {(R+G)/T} -- a threshold -- carrying out -- ****** of the first aforementioned field, and blue -- Furthermore, it is good to **** the damage grain and tinction grain of the third aforementioned field, using value F of the total product for the aforementioned total {(RxGxT)/(R+G+T)} as a threshold.

[0008] Furthermore, drum crack wave detection equipment is connected to the aforementioned photo detector for a drum crack detection. While the electrical signal HM which detects the trough of the optical intensity distribution which irradiated the aforementioned sample grain of rice, the electrical signal H1 which detects the high crest of the aforementioned optical intensity distribution, and the electrical signal H2 which detects the low crest of the aforementioned optical intensity distribution are inputted into the aforementioned judgment control section As for this judgment control section, it is good to distinguish a drum crack grain and a particle size regulation with the electrical signal HM of the aforementioned trough, and to distinguish a drum crack grain and an opaque white grain with aforementioned Yamabe's electrical signals H1 and H2.

[0009]

[Function and Effect] It enabled change of the input voltage to a judgment control section to offer few grain-of-rice quality distinction equipment while it simplified the configuration of an optical light-receiving means and made the manufacturing cost cheap, since the aforementioned detecting element was constituted by total of four photo detectors of the photo detector for long wavelength components, the photo detector for short wavelength components, a transmitted light photo detector, and the photo detector for a drum crack detection.

[0010] ******, blue immaturity, white ****, an opaque white grain, and a particle size regulation are distinguished by the ratio (R/G), respectively. moreover, the aforementioned judgment control

section -- transparency / reflective ratio {(R+G)/T} and a spectrum -- Since the damage grain and the tinction grain were distinguished by the total totaled product {(RxGxT)/(R+G+T)} of three elements of (R), (G), and (T), the distinction with the damage grain of the brown system which was difficult to distinguish, and the tinction grain of a black system became easy conventionally.
[0011] Furthermore, the electrical signal HM which detects the trough of the optical intensity distribution which connected drum crack wave detection equipment to the aforementioned photo detector for a drum crack detection, and irradiated sample grain, Since the electrical signal H1 which detects the high crest of the aforementioned optical intensity distribution, and the electrical signal H2 which detects the low crest of the aforementioned optical intensity distribution are inputted into the aforementioned judgment control section and distinction of a drum crack grain is performed Not only the distinction with a particle size regulation and a drum crack grain but the distinction with the opaque white grain and the partial tinction grain, and drum crack grain which were mixed with the particle size regulation with electrical signals H1 and H2 was attained.
[0012]
[Example] The example of this invention is explained, referring to a drawing. The block diagram, the drawing 4 , and the drawing 5 in which the schematic diagram and the drawing 2 showing [1] the configuration of the whole this invention showing the side elevation of the detecting element of this invention, and showing [3] the circuit of the detecting element of this invention and a judgment control section are an enlarged view of an optical detecting element.
[0013] In drawing 1 , signs 1 are [a rotating disk and the sign 3 of grain-of-rice quality distinction equipment and the sign 2] optical detecting elements. a centering on rotation axis 4 of rotating disk 2 periphery [periphery / of a rotating disk 2] top -- much sampling -- a hole 5 is formed and these sampling -- one grain of grain of rice holds at a time in a hole 5 -- having -- sampling -- the transparent members 31, such as a glass plate, are formed in the hole 5 bottom so that a grain of rice may not fall The rotation drive of the rotating disk 2 is carried out by the motor 6 fixed to revolve to the aforementioned rotation axis 4.
[0014] The optical detecting element 3 is formed so that the vertical side of the aforementioned rotating disk 2 may be put, and it consists of 1st head 3a which mainly detects the color of a grain of rice by the long wavelength component and short wavelength component in the amount of transmitted lights, and the amount of reflected lights, and the 2nd head 3b which mainly detects the drum crack of a grain of rice with the amount of transmitted lights.
[0015] the aforementioned 1st head 3a -- sampling -- with the light source 7 which inclines from the upper part to one grain of grain of rice transported by the hole 5, and irradiates light The dichroic mirror 8 which ****s the amount of perpendicular reflected lights from a grain of rice for a long wavelength component and a short wavelength component, The red light photo detector 9 which detects the quantity of light of a long wavelength component, the green light photo detector 10 which detects the quantity of light of a short wavelength component, and the transmitted light photo detector 11 which receives the amount of perpendicular transmitted lights from a grain of rice are formed. the aforementioned light source 7 -- for example, a halogen lamp etc. -- using it -- optical fibers 13A and 13B -- minding -- sampling -- it is good to lead to the optical irradiation sections 14A and 14B prepared in the upper part of a hole 5 These optical irradiation sections 14A and 14B are formed in the shape of [of reverse 8] a character so that it may face across the length orientation order of a grain of rice (refer to the drawing 4), and a focus is united with the black slit 32 embedded at the aforementioned transparent member 31. A sign 15 is a condensing cylinder and is connected to the aforementioned dichroic mirror 8. Although a dichroic mirror 8 carries out the two piece housing of the light which condensed to a long wavelength component and a short wavelength component, between this dichroic mirror 8 and the aforementioned red light photo detector 9, the 600-700nm band pass filter 16 is formed, for example, and the 500-600nm band pass filter 17 which passes red light and which passes green light is formed between the dichroic mirror 8 and the aforementioned green light photo detector 10.
[0016] Moreover, while optical irradiation section 14C which irradiates a beam of light from the inclination upper part to one grain of grain of rice with the aforementioned light source 7 is prepared, the single photo detector for a drum crack detection 12 which receives the amount of method transmitted lights of slanting from a grain of rice underneath the rotating disk 2 is formed in the

aforementioned 2nd head 3b (refer to the drawing 5). The light source of 2nd head 3b is led to optical irradiation section 14C through optical-fiber 13C that what is necessary is just to use the light of the aforementioned light source 7. It is prepared so that it may incline to the aforementioned rotating disk 2 and a focus may suit the black (for example, 50 degrees) slit 33, and optical irradiation section 14C can irradiate the method beam of light of slanting at a grain of rice.
[0017] next, the timing detection which detects that rotated the rotating disk 2 and the grain of rice came to the predetermined measuring point is shown in drawing 3 -- as -- a rotating disk 2 -- another field -- the aforementioned sampling -- the timing corresponding to the hole 5 -- the timing plate 19 with a hole 18 is formed, and it is carried out by detecting this by the position detection sensors 20 and 20
[0018] Next, drawing 3 explains the input circuit of each detecting signal of the aforementioned red light photo detector 9, the green light photo detector 10, the transmitted light photo detector 11, the photo detector for a drum crack detection 12, and the position detection sensors 20 and 20. While the aforementioned red light photo detector 9, the green light photo detector 10, the transmitted light photo detector 11, and the photo detector for a drum crack detection 12 change and output each quantity of light received to an electrical signal and photo detectors 9, 10, and 11 are connected to amplifier 21, 22, and 23 among the four aforementioned photo detectors, respectively, the photo detector for a drum crack detection 12 is connected to the drum crack wave detection equipment 24. The output signal of this drum crack wave detection equipment 24 is trichotomized, inputs these three output signals and one output signal of a photo detector 12 into amplifier 25, 26, and 27, respectively, and forms an AND circuit. And the output signal from amplifier 21, 22, 23, 25, 26, and 27 is inputted into A/D converter 28. while inputting into CPU29 which A/D conversion of the inputted signal is carried out by A/D converter 28, and serves as a judgment control section -- timing -- the position detection sensors 20 and 20 which detect a hole 18 are also inputted into CPU29
[0019] Furthermore, the selector 30 which sorts out a particle size regulation and a poor grain to six kinds is connected to CPU29 used as a judgment control section. This selector 30 serves as the configuration blown away and sorted out in the orientation which changes with compressed airs sent from a compressor (not shown) according to the optical distinction result of aforementioned CPU29.
[0020] Next, the operation in the above-mentioned configuration is explained. sampling of a rotating disk 2 -- if the grain of rice put on the hole 5 reaches to the optical irradiation sections 14A and 14B, light will be irradiated from the upper part which inclined to the grain-of-rice length orientation Incidence of the light by which diffuse reflection was carried out a front face and inside [of a grain of rice] the grain of rice is carried out to a dichroic mirror 8 from the condensing cylinder 15, and a two piece housing is carried out to a long wavelength component and a short wavelength component. And a long wavelength component is received by the red light photo detector 9, and a short wavelength component is received by the green light photo detector 10. On the other hand, the light by which diffuse transmission was carried out in the interior of a grain of rice is received by the transmitted light photo detector 11. Each quantity of light of each photo detectors 9, 10, and 11 is changed into an electrical signal, and is inputted into CPU29 through the amplifier 21, 22, and 23 and A/D converter 28.
[0021] The inside of CPU29 memorizes the electrical signal of each aforementioned quantity of light inputted from A/D converter 28 to RAM (not shown), calculates the ratio of each quantity of light from this signal, and uses it as the judgment data for judging a quality rank. Namely, while transparency / reflective ratio {(R+G)/T} is calculated from the amount (T) of transmitted lights memorized in RAM, and the diffuse reflection light by the sum of a long wavelength component (R) and a short wavelength component (G) a long wave -- the spectrum from a long component (R) and a short wavelength component (G) -- a ratio (R/G) is calculated and it memorizes to RAM as judgment data Moreover, aforementioned CPU29 computes total and the total product from a long wavelength component (R), a short wavelength component (G), and the amount (T) of transmitted lights, calculates the total totaled product {(RxGxT)/(R+G+T)}, and memorizes it to RAM as judgment data. Since the total product for this total evaluates the degree of the variation in the quantity of light component of three elements of (R), (G), and (T), it asks for it. Table 1 explains this in detail.
[0022]
[Table 1]

	（直方体の体積）＝（長さ）×（幅）×（高さ）			
パターン1	64	4	4	4
パターン2	64	1	1	64
パターン3	64	2	2	16
パターン4	64	4	2	8
パターン5	64	8	1	8

Table 1 shows the combination of each length at the time of computing the volume of a rectangular parallelepiped. For example, when the volume of a rectangular parallelepiped is considered, it turns out that the combination from which a volume is set to 64 becomes five patterns. However, even if a volume is set to the 64 [same] in this way, when a difference arises to each length and the example of Table 1 shows, total (length + width-of-face + height) of a component is set to 12 by the pattern 1, and there will be least dispersion in a component. This principle is applied to (R), (G), and (T), and the total totaled product {(RxGxT)/(R+G+T)} is calculated.

[0023] The quantity of light is changed into an electrical signal like [the aforementioned photo detector for a drum crack detection 12] the above. And if a drum crack grain is detected by this photo detector for a drum crack detection 12, once it falls in the shape of an impression, the wave of the electrical signal with the fraction which goes up again will be detected. At this time, the drum crack wave detection equipment 24 outputs three electrical signals of the electrical signal HM which detects the trough of a drum crack wave, the electrical signal H1 which detects the low crest of a drum crack wave, and the electrical signal H2 which detects the high crest of a drum crack wave (refer to the drawing 8). And these electrical signals HM, H1, and H2 are inputted into CPU29 through the amplifier 25, 26, and 27 and A/D converter 28. Within CPU29, while the aforementioned electrical signals HM, H1, and H2 are memorized to RAM, a drum crack is distinguished as compared with a predetermined threshold.

[0024] Next, a judgment of the quality rank of a grain of rice is explained. the quality rank of a grain of rice -- especially -- a judgment of tinction -- transparency / reflective ratio {(R+G)/T} and a spectrum -- three judgment data of a ratio (R/G) and the total totaled product {(RxGxT)/(R+G+T)} are used, and three judgment data of electrical signals HM, H1, and H2 are used for a judgment of a drum crack

[0025] if measurement of a husked rice is explained with reference to the drawing 6 and the drawing 7 -- step 101 and step 102 of drawing 6 -- a spectrum -- it distinguishes by the ratio (R/G) It enabled it to distinguish in a white system and tinction system, there being the characteristic feature of the degree of a red system (tea system) being [130-170] stronger at 170 or more more strongly [an optical ratio has the more strong degree of a green system at this rate at 130 or less, and / the degree of a white system], and being reflected, enabling it to distinguish a threshold in the color system of a green system and others as 130 at step 101, and using a threshold as 170 at step 102 if the judgment graph of drawing 7 explains this -- the quadrature axis of a graph -- a spectrum -- a ratio (R/G) -- taking -- a threshold 130,170 -- ****** and blue -- it ****s to the first unripe field to mix, the second field which white ****, an opaque white grain, and a particle size regulation mix, and the third field which a damage grain and a tinction grain mix

[0026] At steps 103, 104, and 105 of drawing 6 , it distinguishes by transparency / reflective ratio {(R+G)/T}. This transparency / reflective ratio has the characteristic feature which is hard to penetrate so that a numeric value becomes large, and explains this with the judgment graph of drawing 7 . On it, along the axis of ordinate of a graph, transparency / reflective ratio {(R+G)/T} is taken, ****** and blue unripe rice of the first field are distinguished with a threshold 230, and white ****, the opaque white grain, and particle size regulation of the second field are distinguished with thresholds 460 and 220 on it.

[0027] next, the step 106 of drawing 6 -- setting -- the above -- a spectrum -- the damage grain of the brown system which was not able to be classified according to the ratio and transparency / reflective ratio, and the tinction grain of the black system with transparency of light worse than this damage grain are distinguished If the judgment graph of drawing 7 explains this, it will distinguish by whether the value of the total totaled product {(RxGxT)/(R+G+T)} computed from (R), (G), and (T)

is larger than a threshold 90, and the damage grain and tinction grain of the third field will be distinguished.

[0028] Furthermore, in step 107 of drawing 6 , the drum crack of the grain of rice judged to be a particle size regulation at the aforementioned step 105 is judged. Three judgment data of electrical signals HM, H1, and HH2 are used for a judgment of this drum crack. that is, -- if aforementioned CPU29 is below a predetermined threshold by the trough HM in the drum crack wave of drawing 8 -- a particle size regulation and a drum crack grain -- or a particle size regulation, and an opaque white grain and a partial tinction grain are distinguished Although it has the fraction which goes up again once the drum crack wave shown in drawing 8 (a) falls in the shape of an impression, this wave may be similar with the opaque white grain and partial tinction grain mixed in the particle size regulation (refer to drawing 8 (b)). In order to distinguish this opaque white grain and partial tinction grain, and a drum crack grain, aforementioned CPU29 calculates further the **** exponent which compared the **** level by the sum of an electrical signal H1 and the electrical signal H2 with an electrical signal H1 and the electrical signal H2. And this **** level and a **** exponent may distinguish an opaque white grain and a partial tinction grain, and a drum crack grain by whether a predetermined threshold is reached.

[0029] next -- if measurement of a white rice is explained with reference to the drawing 9 and the drawing 10 -- measurement of a white rice -- a spectrum -- it is good to use two judgment data, a ratio (R/G) and transparency / reflective ratio {(R+G)/T} step 110 -- a spectrum -- with [a ratio (R/G) is 150 or more, and / transparency / reflective ratio {(R+G)/T}] 180 [or less], it is judged as ********, and if it comes out other than this and it is, it will result in step 111 step 111 -- a spectrum -- with [a ratio (R/G)] 130 [or more], it is judged as a tinction grain, and if it comes out other than this and it is, it will result in step 112 step 112 -- a spectrum -- with [a ratio (R/G)] 80 [or more], it is judged as a damage grain, and if it comes out other than this and it is, it will result in step 113 At step 113, with [transparency / reflective ratio {(R+G)/T}] 80 [or more], it is judged as a particle size regulation, and with 80 [or less], it is judged as ****.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing the configuration of the whole this invention.
[Drawing 2] It is the side elevation of the detecting element of this invention.
[Drawing 3] It is the block diagram showing the circuit of the detecting element of this invention, and a judgment control section, and is **.
[Drawing 4] It is the enlarged view showing the 1st head of an optical detecting element.
[Drawing 5] It is the enlarged view showing the 2nd head of an optical detecting element.
[Drawing 6] It is a flow chart at the time of measuring a husked rice.
[Drawing 7] It is drawing showing the relation of a distribution of each quantity of light ratio at the time of measuring a husked rice.
[Drawing 8] It is drawing showing the detection wave of a drum crack grain, opaque white and a partial tinction grain, and a particle size regulation.
[Drawing 9] It is a flow chart at the time of measuring a white rice.
[Drawing 10] It is drawing showing the relation of a distribution of each quantity of light ratio at the time of measuring a white rice.
[Description of Notations]
1 Grain-of-Rice Quality Distinction Equipment
2 Rotating Disk
3 Optical Detecting Element
4 Rotation Axis
5 sampling -- a hole
6 Motor
7 Light Source
8 Dichroic Mirror
9 Red Light Photo Detector
10 Green Light Photo Detector
11 Transmitted Light Photo Detector
12 Photo Detector for Drum Crack Detection
13 Optical Fiber
14 Optical Irradiation Section
15 Condensing Cylinder
16 Band Pass Filter
17 Band Pass Filter
18 timing -- a hole
19 Timing Plate
20 Position Detection Sensor
21 Amplifier
22 Amplifier
23 Amplifier
24 Drum Crack Wave Detection Equipment
25 Amplifier
26 Amplifier

27 Amplifier
28 A/D Converter
29 CPU
30 Selector
31 Transparent Member
32 Black Slit
33 Black Slit

[Translation done.]

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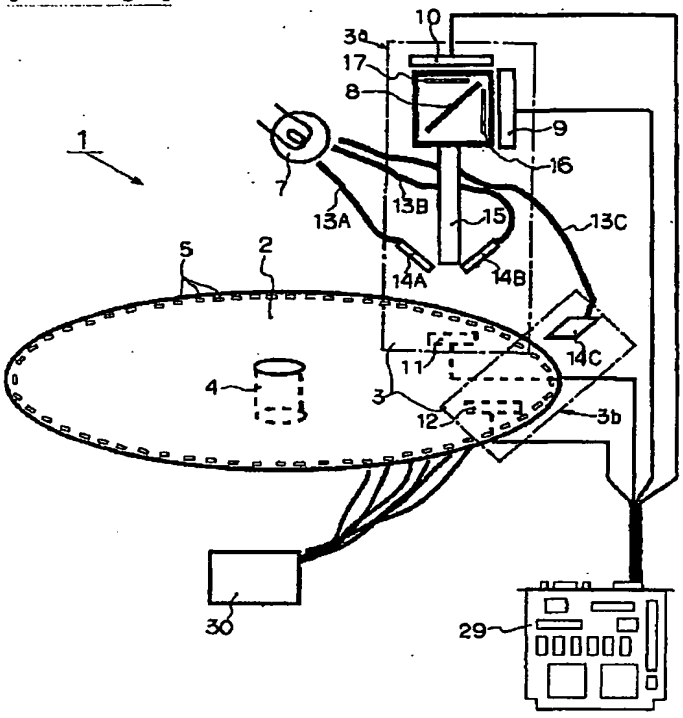
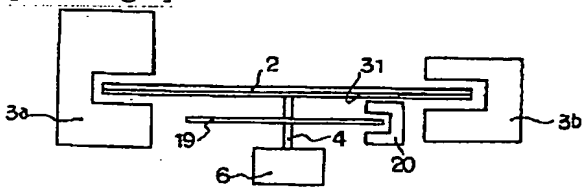
DRAWINGS

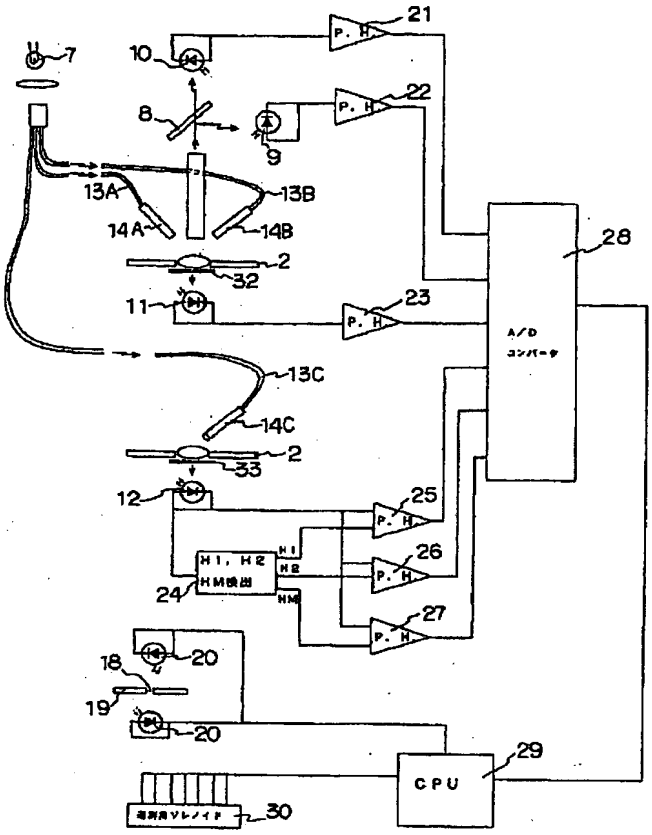
[Drawing 1]



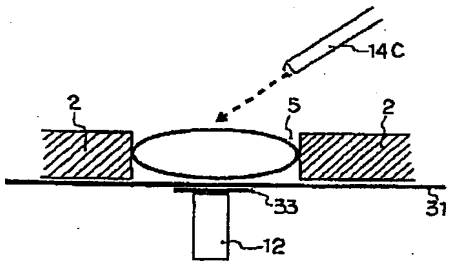
[Drawing 2]



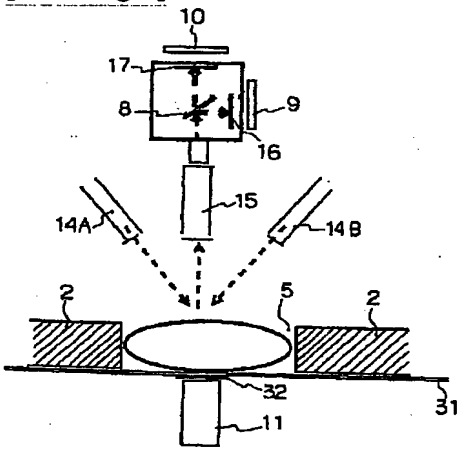
[Drawing 3]



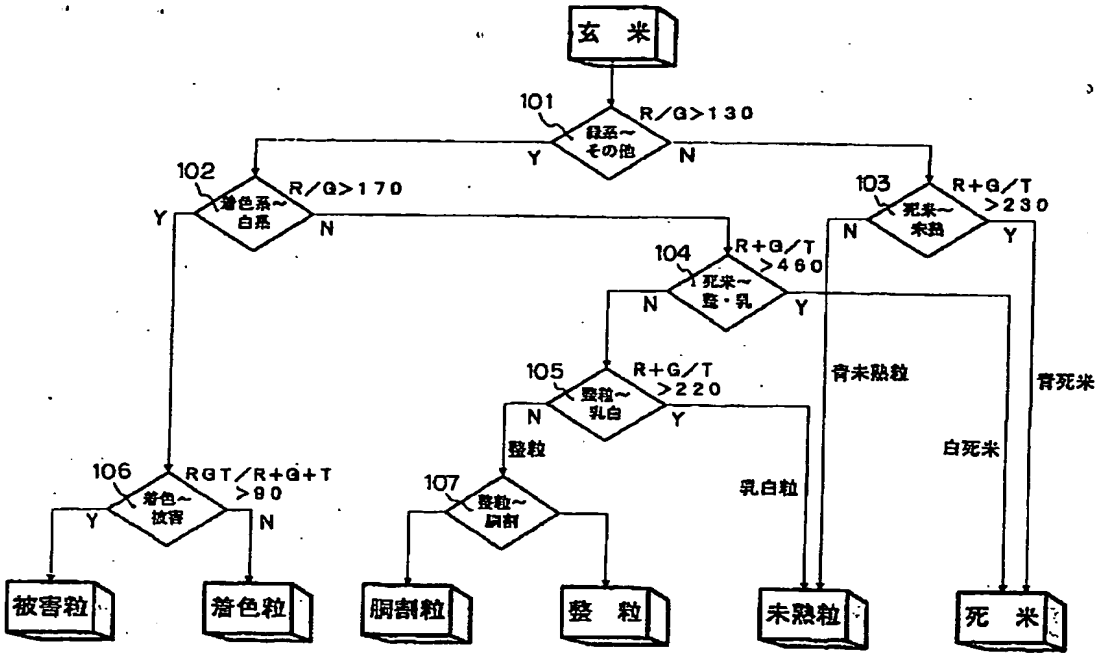
[Drawing 5]



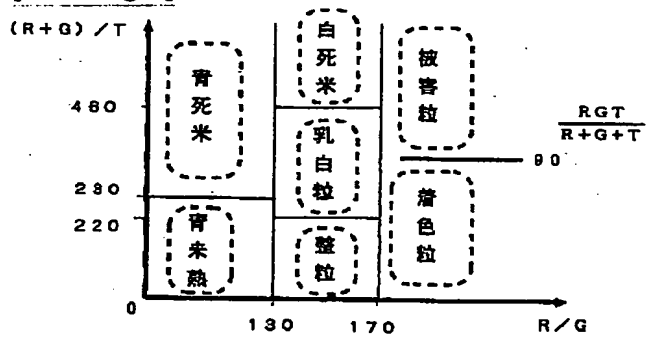
[Drawing 4]



[Drawing 6]



[Drawing 7]



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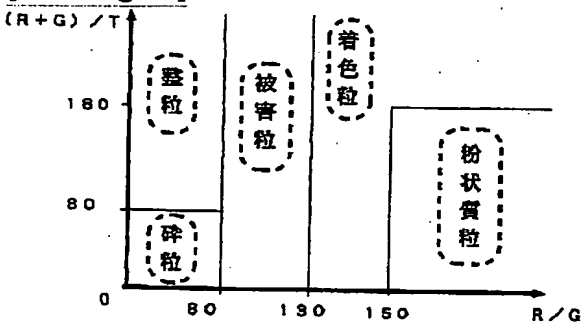

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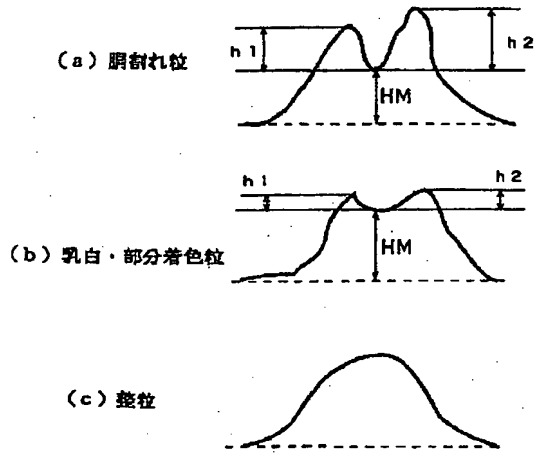

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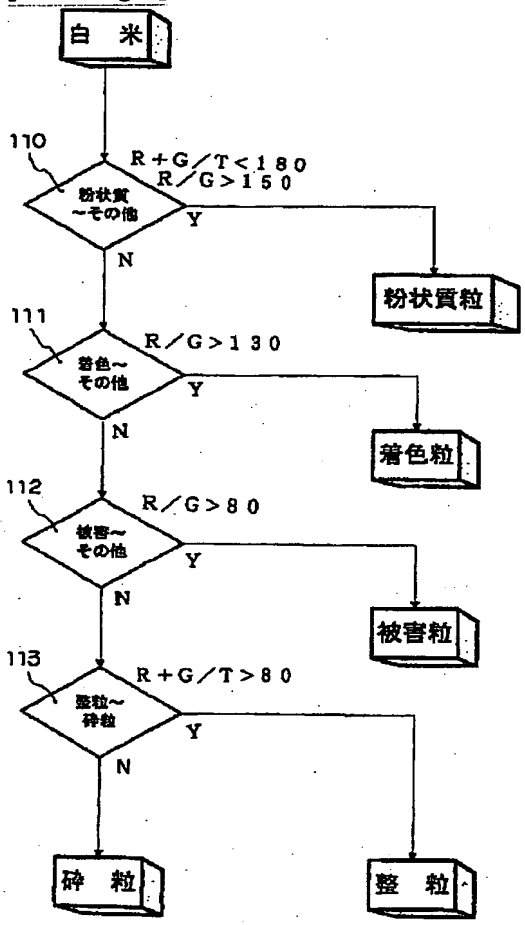

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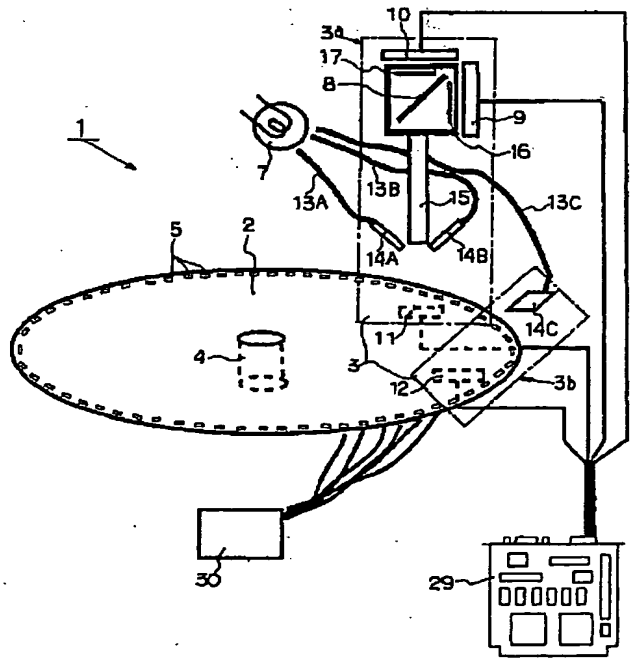
(54)【発明の名称】　米粒品位判別装置

(57)【要約】

【目的】　光学的受光手段の構成を簡略化して製造コストを安価にするとともに、演算処理回路への入力電圧の変動が少ない米粒品位判別装置を提供する

【構成】　試料採取孔５により移送される一粒の試料穀粒に対し傾斜上方から光線を照射する光源７と、前記試料穀粒からの垂直反射光量を長波長成分と短波長成分とにそれぞれ区分するダイクロイックミラー８と、区分されたそれぞれの波長の光量を受光する二つの受光素子９，１０と、前記試料穀粒からの垂直透過光量を受光する透過光受光素子１１とを設けるとともに、前記光源７により一粒の試料穀粒に対し傾斜上方から光線を照射し、前記試料穀粒からの斜方透過光量を受光する胴割れ検出用受光素子１２を設ける



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【特許請求の範囲】

【請求項１】　外周縁の円周方向に等間隔に複数の試料採取孔を有する回転円板と、前記試料採取孔により移送される試料米粒の各一粒毎に光線を照射する光源と、該光源により照射して得られた前記試料米粒の透過反射光量を検出する検知部と、該検知部から入力された検出信号を所定値と比較して前記試料米粒の品質ランクを決定する判定制御部とを備えた米粒品位判別装置であって、前記検知部は、前記試料採取孔により移送される一粒の試料米粒に対し前記光源から誘導された光線を傾斜上方二箇所から照射する第一照射部と、前記試料米粒からの垂直反射光量を長波長成分（Ｒ）と短波長成分（Ｇ）とにそれぞれ区分するダイクロイックミラーと、区分されたそれぞれの波長の光量を受光する二つの受光素子と、前記試料米粒からの垂直透過光量（Ｔ）を受光する透過光受光素子とを設けるとともに、前記光源からの光線を前記試料米粒に対し傾斜上方から照射する第二照射部と、該第二照射部により照射して得られた前記試料穀粒からの斜方透過光量を受光する胴割れ検出用受光素子とを設けたことを特徴とする米粒品位判別装置。

【請求項２】　前記判定制御部は、前記垂直透過光量（Ｔ）と、前記長波長成分（Ｒ）及び短波長成分（Ｇ）の和による拡散反射光とから透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝を演算するとともに、前記長波長成分と短波長成分との分光比（Ｒ／Ｇ）を演算し、更に、前記垂直透過光量（Ｔ）と長波長成分（Ｒ）及び短波長成分（Ｇ）からこれら三要素の総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝を演算して、前記試料米粒の品質ランクを決定する判定データとする請求項１記載の米粒品位判別装置。

【請求項３】　前記判定データと予め定めた判定アルゴリズムによって品質ランクを決定するものであって、前記判定アルゴリズムは、前記分光比（Ｒ／Ｇ）の値Ａ，Ｂをしきい値として青死米，青未熟の混入する第一領域と、白死米，乳白粒，整粒の混入する第二領域と、被害粒，着色粒の混入する第三領域とに区分し、前記透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝の値Ｃ，Ｄ，Ｅをしきい値として前記第一領域の青死米と青未熟及び前記第二領域の白死米と乳白粒と整粒とをそれぞれ区分し、更に、前記総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝の値Ｆをしきい値として前記第三領域の被害粒と着色粒とを区分してなる請求項２記載の米粒品位判別装置。

【請求項４】　前記胴割れ検出用受光素子に胴割れ波形検出装置を接続して、前記試料米粒に照射した光強度分布の谷部を検出する電気信号ＨＭと、前記光強度分布の高い山を検出する電気信号Ｈ１と、前記光強度分布の低い山を検出する電気信号Ｈ２とを前記判定制御部に入力するとともに、該判定制御部は、前記谷部の電気信号ＨＭにより胴割れ粒と整粒とを判別し、前記山部の電気信号Ｈ１及びＨ２により胴割れ粒と乳白粒とを判別してなる請求項１，２又は３記載の米粒品位判別装置。

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【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、玄米や白米の品質を判別する米粒品位判別装置に関する。

【０００２】

【従来の技術】従来、米粒の品質を判別する装置として、例えば、特公平３－６０３８２号公報、特開昭６４－２８５４３号公報に開示されたものが知られている。これらの公報に開示された発明は、外周縁に複数個の試料採取孔を設けた円盤を傾斜回転させ、試料玄米の各玄米一粒毎に光を照射し、拡散透過光量および拡散反射光量と拡散反射光中任意の二波長の光量と前記各玄米一粒毎の二位置の透過光量とをそれぞれ検知し、前記各玄米一粒毎の品質を分類すべく前記各光量の比を判定処理するものである。そして、前記各光量を検出してその比を演算し判定処理することにより、玄米の品質をより精細に分類し、しかも粒形による分類の判定精度への影響を排除できるものである。

【０００３】

【発明が解決しようとする課題】上記従来の米粒品位判別装置は、玄米の品質をより精細に分類し、粒形による分類の判定精度への影響を排除するため、拡散透過光量と、拡散反射光量と、該拡散反射光量中の任意の二波長の光量と、各玄米一粒毎の二位置の透過光量とをそれぞれ受光するために光学的受光手段として合計６種類の受光素子を設ける必要があった。これにより、光学的受光手段は構成が複雑となり、製造コスト高となる欠点があった。また、受光素子が多数設けられているため判定制御部への入力電圧の変動が大きく、米粒の測定精度にばらつきが生じる恐れがあった。

【０００４】本発明は、上記問題点にかんがみ、光学的受光手段の構成を簡略化して製造コストを安価にするとともに、判定制御部への入力電圧の変動が少ない米粒品位判別装置を提供することを技術的課題とする。

【０００５】

【課題を解決するための手段】上記課題を解決するため本発明は、外周縁の円周方向に等間隔に複数の試料採取孔を有する回転円板と、前記試料採取孔により移送される試料米粒の各一粒毎に光線を照射する光源と、該光源により照射して得られた前記試料米粒の透過反射光量を検出する検知部と、該検知部から入力された検出信号を所定値と比較して前記試料米粒の品質ランクを決定する判定制御部とを備えた米粒品位判別装置であって、前記検知部は、前記試料採取孔により移送される一粒の試料米粒に対し前記光源から誘導された光線を傾斜上方二箇所から照射する第一照射部と、前記試料米粒からの垂直反射光量を長波長成分（Ｒ）と短波長成分（Ｇ）とにそれぞれ区分するダイクロイックミラーと、区分されたそれぞれの波長の光量を受光する二つの受光素子と、前記

試料米粒からの垂直透過光量（Ｔ）を受光する透過光受光素子とを設けるとともに、前記光源からの光線を前記試料米粒に対し傾斜上方から照射する第二照射部と、該第二照射部により照射して得られた前記試料穀粒からの斜方透過光量を受光する胴割れ検出用受光素子とを設ける、という技術的手段を講じた。

【０００６】また、前記判定制御部は、前記垂直透過光量（Ｔ）と、前記長波長成分（Ｒ）及び短波長成分（Ｇ）の和による拡散反射光とから透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝を演算するとともに、前記長波長成分と短波長成分との分光比（Ｒ／Ｇ）を演算し、更に、前記垂直透過光量（Ｔ）と長波長成分（Ｒ）及び短波長成分（Ｇ）からこれら三要素の総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝を演算して、前記試料米粒の品質ランクを決定する判定データとするとよい。

【０００７】そして、前記判定データと予め定めた判定アルゴリズムによって品質ランクを決定するものであって、前記判定アルゴリズムは、前記分光比（Ｒ／Ｇ）の値Ａ，Ｂをしきい値として青死米，青未熟の混入する第一領域と、白死米，乳白粒，整粒の混入する第二領域と、被害粒，着色粒の混入する第三領域とに区分し、前記透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝の値Ｃ，Ｄ，Ｅをしきい値として前記第一領域の青死米と青未熟及び前記第二領域の白死米と乳白粒と整粒とをそれぞれ区分し、更に、前記総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝の値Ｆをしきい値として前記第三領域の被害粒と着色粒とを区分するとよい。

【０００８】更に、前記胴割れ検出用受光素子に胴割れ波形検出装置を接続して、前記試料米粒に照射した光強度分布の谷部を検出する電気信号ＨＭと、前記光強度分布の高い山を検出する電気信号Ｈ１と、前記光強度分布の低い山を検出する電気信号Ｈ２とを前記判定制御部に入力するとともに、該判定制御部は、前記谷部の電気信号ＨＭにより胴割れ粒と整粒とを判別し、前記山部の電気信号Ｈ１及びＨ２により胴割れ粒と乳白粒とを判別するとよい。

【０００９】

【作用及び効果】前記検出部は、長波長成分用の受光素子と、短波長成分用の受光素子と、透過光受光素子と、胴割れ検出用受光素子との合計４つの受光素子により構成されているので、光学的受光手段の構成を簡略化して製造コストを安価にするとともに、判定制御部への入力電圧の変動が少ない米粒品位判別装置を提供することを可能にした。

【００１０】また、前記判定制御部は、透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝と、分光比（Ｒ／Ｇ）とにより青死米，青未熟，白死米，乳白粒，整粒をそれぞれ区別し、（Ｒ），（Ｇ），（Ｔ）の３要素の総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝により被害粒と着色粒とを区別するので、従来、判別が困難であった茶色系の被害粒と黒色系の着色粒との判別が容易になった。

【００１１】更に、前記胴割れ検出用受光素子に胴割れ波形検出装置を接続し、試料穀粒に照射した光強度分布の谷部を検出する電気信号ＨＭと、前記光強度分布の高い山を検出する電気信号Ｈ１と、前記光強度分布の低い山を検出する電気信号Ｈ２とを前記判定制御部に入力して胴割れ粒の判別が行われるので、整粒と胴割れ粒との判別だけでなく、電気信号Ｈ１とＨ２とにより整粒に混じった乳白粒・部分着色粒と胴割れ粒との判別も可能となった。

【００１２】

【実施例】本発明の実施例を図面を参照しながら説明する。図１は本発明の全体の構成を示す概略図、図２は本発明の検出部の側面図、図３は本発明の検出部と判定制御部の回路を示すブロック図、図４及び図５は光学的検出部の拡大図である。

【００１３】図１において、符号１は米粒品位判別装置、符号２は回転円板、符号３は光学的検出部である。回転円板２の周縁には、回転円板２の回転軸４を中心とする円周上に多数の試料採取孔５を設ける。そして、これら試料採取孔５に米粒が一粒ずつ収容され、試料採取孔５の下側には米粒が落下しないようにガラス板等の透明部材３１が設けられる。回転円板２は、前記回転軸４に軸着したモータ６によって回転駆動される。

【００１４】光学的検出部３は、前記回転円板２の上下面を挟み込むように設けられ、透過光量と反射光量中の長波長成分及び短波長成分とにより主に米粒の色彩を検知する第１ヘッド３ａと、透過光量により主に米粒の胴割れを検出する第２ヘッド３ｂとから構成される。

【００１５】前記第１ヘッド３ａは、試料採取孔５により移送される一粒の米粒に対し上方から傾斜して光を照射する光源７と、米粒からの垂直反射光量を長波長成分と短波長成分とに区分するダイクロイックミラー８と、長波長成分の光量を検知する赤色光受光素子９と、短波長成分の光量を検知する緑色光受光素子１０と、米粒からの垂直透過光量を受光する透過光受光素子１１とが設けられる。前記光源７は、例えば、ハロゲンランプ等を使用し、光ファイバー１３Ａ，１３Ｂを介して試料採取孔５の上方に設けた光照射部１４Ａ，１４Ｂへ導くとよい。該光照射部１４Ａ，１４Ｂは、米粒の長さ方向の前後を挟むように逆八の字状に設けられ（図４参照）、前記透明部材３１に埋め込まれた黒色スリット３２に焦点が合わされる。符号１５は集光筒であり、前記ダイクロイックミラー８に接続してある。ダイクロイックミラー８は集光した光を長波長成分と短波長成分とに二分割するのであるが、該ダイクロイックミラー８と前記赤色光受光素子９との間には、赤色光を通過させる例えば６００～７００ｎｍのバンドパスフィルター１６を設け、ダイクロイックミラー８と前記緑色光受光素子１０との間には、緑色光を通過させる例えば５００～６００ｎｍの

バンドパスフィルター１７を設けている。

【００１６】また、前記第２ヘッド３ｂには、前記光源７により一粒の米粒に対し傾斜上方から光線を照射する光照射部１４Ｃを設けるとともに、回転円板２の下方に米粒からの斜方透過光量を受光する単一の胴割れ検出用受光素子１２を設ける（図５参照）。第２ヘッド３ｂの光源は、前記光源７の光を利用すればよく、光ファイバー１３Ｃを介して光照射部１４Ｃへと導く。光照射部１４Ｃは、前記回転円板２に対して傾斜して（例えば５０度）黒色スリット３３に焦点が合うように設けられ、米粒に斜方光線を照射することが可能である。

【００１７】次に、回転円板２を回転させて米粒が所定の測定位置に来たことを検知するタイミング検出は、図３に示すように回転円板２とは別体に前記試料採取孔５に対応したタイミング孔１８を持つタイミング板１９が設けられ、これを位置検出センサー２０，２０で検出することにより行われる。

【００１８】次に、図３により前記赤色光受光素子９、緑色光受光素子１０、透過光受光素子１１、胴割れ検出用受光素子１２及び位置検出センサー２０，２０の各検出信号の入力回路について説明する。前記赤色光受光素子９、緑色光受光素子１０、透過光受光素子１１及び胴割れ検出用受光素子１２は、受光されるそれぞれの光量を電気信号に変換して出力し、前記４つの受光素子のうち受光素子９，１０，１１は増幅器２１，２２，２３にそれぞれ接続する一方、胴割れ検出用受光素子１２は、胴割れ波形検出装置２４に接続する。該胴割れ波形検出装置２４の出力信号は３分割され、この３つの出力信号と受光素子１２の一方の出力信号とを増幅器２５，２６，２７にそれぞれ入力してアンド回路を形成する。そして、増幅器２１，２２，２３，２５，２６，２７からの出力信号はＡ／Ｄコンバータ２８に入力する。入力した信号は、Ａ／Ｄコンバータ２８によりＡ／Ｄ変換され、判定制御部となるＣＰＵ２９に入力するとともに、タイミング孔１８を検出する位置検出センサー２０，２０もＣＰＵ２９に入力する。

【００１９】更に、判定制御部となるＣＰＵ２９には、＊整粒と不良粒とを６種類に選別する選別装置３０を接続する。該選別装置３０はコンプレッサー（図示せず）から送られる圧搾空気により前記ＣＰＵ２９の光学的判別結果に従って異なる方向へ吹き飛ばし選別する構成となっている。

【００２０】次に、上記構成における作用について説明する。回転円板２の試料採取孔５に乗せられた米粒が光照射部１４Ａ，１４Ｂへ到達すると、米粒長さ方向に対して傾斜した上方から光が照射される。米粒の表面及び米粒内部で拡散反射された光は、集光筒１５からダイクロイックミラー８に入射され、長波長成分と短波長成分とに二分割される。そして、長波長成分は赤色光受光素子９に受光され、短波長成分は緑色光受光素子１０に受光される。一方、米粒内部を拡散透過された光は、透過光受光素子１１に受光される。各受光素子９、１０、１１のそれぞれの光量は電気信号に変換され、増幅器２１，２２，２３及びＡ／Ｄコンバータ２８を経てＣＰＵ２９に入力される。

【００２１】ＣＰＵ２９内は、Ａ／Ｄコンバータ２８から入力する前記各光量の電気信号をＲＡＭ（図示せず）に記憶し、この信号から各光量の比を演算し、品質ランクを判定するための判定データとする。すなわち、ＲＡＭ内に記憶した透過光量（Ｔ）と、長波長成分（Ｒ）と短波長成分（Ｇ）との和による拡散反射光とから透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝を演算するとともに、長波長成分（Ｒ）と短波長成分（Ｇ）とから分光比（Ｒ／Ｇ）を演算し、判定データとしてＲＡＭに記憶する。また、前記ＣＰＵ２９は、長波長成分（Ｒ）と短波長成分（Ｇ）と透過光量（Ｔ）とから総和と総積とを算出し、総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝を演算し、判定データとしてＲＡＭに記憶する。この総和分の総積は（Ｒ），（Ｇ），（Ｔ）の３要素の光量成分のバラツキの度合いを数値化するために求めたものである。これを、表１により詳細に説明する。

【００２２】

【表１】

（直方体の体積）＝（長さ）×（幅）×（高さ）

パターン１	６４	４	４	４
パターン２	６４	１	１	６４
パターン３	６４	２	２	１６
パターン４	６４	４	２	８
パターン５	６４	８	１	８

表１は、直方体の体積を算出する際の各長さの組み合わせを示したものである。例えば、直方体の体積を考えると、体積が６４になる組み合わせは５パターンになることが分かる。しかし、このように体積が同じ６４になるものであっても、それぞれの長さには違いが生じ、表１の例で示すとパターン１が成分の総和（長さ＋幅＋高＊さ）が１２となり、いちばん成分のばらつきの少ないことになる。この原理を（Ｒ），（Ｇ），（Ｔ）に応用して総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝を演算したものである。

【００２３】前記胴割れ検出用受光素子１２も前記同様に光量を電気信号に変換する。そして、該胴割れ検出用

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受光素子１２に胴割れ粒が検出されると、一旦くぼみ状に低下してから再び上昇する部分をもつ電気信号の波形が検出される。このとき、胴割れ波形検出装置２４は、胴割れ波形の谷を検出する電気信号ＨＭと、胴割れ波形の低い山を検出する電気信号Ｈ１と、胴割れ波形の高い山を検出する電気信号Ｈ２との３つの電気信号を出力する（図８参照）。そして、この電気信号ＨＭ，Ｈ１，Ｈ２は、増幅器２５，２６，２７及びＡ／Ｄコンバータ２８を経てＣＰＵ２９に入力される。ＣＰＵ２９内では、前記電気信号ＨＭ，Ｈ１，Ｈ２をＲＡＭに記憶するとともに、所定のしきい値と比較して胴割れの判別を行う。

【００２４】次に、米粒の品質ランクの判定について説明する。米粒の品質ランク、特に、着色の判定には、透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝と、分光比（Ｒ／Ｇ）と、総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝との３つの判定データを使い、胴割れの判定には、電気信号ＨＭ，Ｈ１，Ｈ２の３つの判定データを使う。

【００２５】図６及び図７を参照して玄米の測定について説明すると、図６のステップ１０１及びステップ１０２では分光比（Ｒ／Ｇ）により判別を行う。この分光比は１３０以下では緑系の度合いがより強く、１３０～１７０では白系の度合いがより強く、また、１７０以上では赤系（茶系）の度合いがより強く映るという特徴があり、ステップ１０１ではしきい値を１３０として緑系とその他の色系に区別できるようにし、ステップ１０２ではしきい値を１７０として白系と着色系とに区別できるようにした。これを図７の判定グラフにより説明すると、グラフの横軸には、分光比（Ｒ／Ｇ）をとり、しきい値１３０，１７０により青死米，青未熟の混入する第一領域と、白死米，乳白粒，整粒の混入する第二領域と、被害粒，着色粒の混入する第三領域とに区分する。

【００２６】図６のステップ１０３、１０４及び１０５では透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝により判別を行う。この透過・反射比は数値が大きくなるほど透過しにくい特徴があり、これを図７の判定グラフにより説明する。グラフの縦軸には、透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝をとり、しきい値２３０により第一領域の青死米と青未熟米とを区別し、しきい値４６０と２２０により第二領域の白死米と乳白粒と整粒とを区別する。

【００２７】次に、図６のステップ１０６においては、前記分光比及び透過・反射比では分類不可能であった茶色系の被害粒と、該被害粒より光の透過が悪い黒色系の着色粒とを判別する。これを図７の判定グラフにより説明すると、（Ｒ），（Ｇ），（Ｔ）から算出した総和分の総積｛（Ｒ×Ｇ×Ｔ）／（Ｒ＋Ｇ＋Ｔ）｝の値がしきい値９０より大きいか否かで判別し、第三領域の被害粒と着色粒とを区別する。

【００２８】更に、図６のステップ１０７においては、前記ステップ１０５で整粒と判断された米粒の胴割れの判定を行う。該胴割れの判定には、電気信号ＨＭ，Ｈ

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１，ＨＨ２の３つの判定データを使う。つまり、前記ＣＰＵ２９は図８の胴割れ波形における谷ＨＭにより所定のしきい値以下であれば、整粒と胴割れ粒とを、又は、整粒と乳白粒・部分着色粒とを判別する。図８（ａ）に示す胴割れ波形は、一旦くぼみ状に低下してから再び上昇する部分を持っているが、この波形は整粒に混入した乳白粒・部分着色粒と類似することがある（図８（ｂ）参照）。この乳白粒・部分着色粒と胴割れ粒とを判別するため、更に、前記ＣＰＵ２９は、電気信号Ｈ１と電気信号Ｈ２との和による胴割レベルと、電気信号Ｈ１と電気信号Ｈ２とを比較した胴割指数を演算する。そして、この胴割レベル及び胴割指数が所定のしきい値に到達するか否かにより乳白粒・部分着色粒と胴割れ粒とを判別することもある。

【００２９】次に、図９及び図１０を参照して白米の測定について説明すると、白米の測定では分光比（Ｒ／Ｇ）及び透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝の２つの判定データを用いるとよい。ステップ１１０では分光比（Ｒ／Ｇ）が１５０以上で、かつ、透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝が１８０以下であれば粉状質粒と判断し、それ以外であればステップ１１１に至る。ステップ１１１では分光比（Ｒ／Ｇ）が１３０以上であれば着色粒と判断し、それ以外であればステップ１１２に至る。ステップ１１２では分光比（Ｒ／Ｇ）が８０以上であれば被害粒と判断し、それ以外であればステップ１１３に至る。ステップ１１３では透過・反射比｛（Ｒ＋Ｇ）／Ｔ｝が８０以上であれば整粒と判断し、８０以下であれば砕粒と判断する。

【図面の簡単な説明】

【図１】本発明の全体の構成を示す概略図である。

【図２】本発明の検出部の側面図である。

【図３】本発明の検出部と判定制御部の回路を示すブロック図であ

【図４】光学的検出部の第１ヘッドを示す拡大図である。

【図５】光学的検出部の第２ヘッドを示す拡大図である。

【図６】玄米を測定する際のフローチャートである。

【図７】玄米を測定する際の各光量比の分布の関係を示す図である。

【図８】胴割れ粒、乳白・部分着色粒及び整粒の検出波形を示す図である。

【図９】白米を測定する際のフローチャートである。

【図１０】白米を測定する際の各光量比の分布の関係を示す図である。

【符号の説明】

１　米粒品位判別装置
２　回転円板
３　光学的検出部
４　回転軸

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5　試料採取孔
6　モータ
7　光源
8　ダイクロイックミラー
9　赤色光受光素子
10　緑色光受光素子
11　透過光受光素子
12　胴割れ検出用受光素子
13　光ファイバー
14　光照射部
15　集光筒
16　バンドパスフィルター
17　バンドパスフィルター
18　タイミング孔
19　タイミング板

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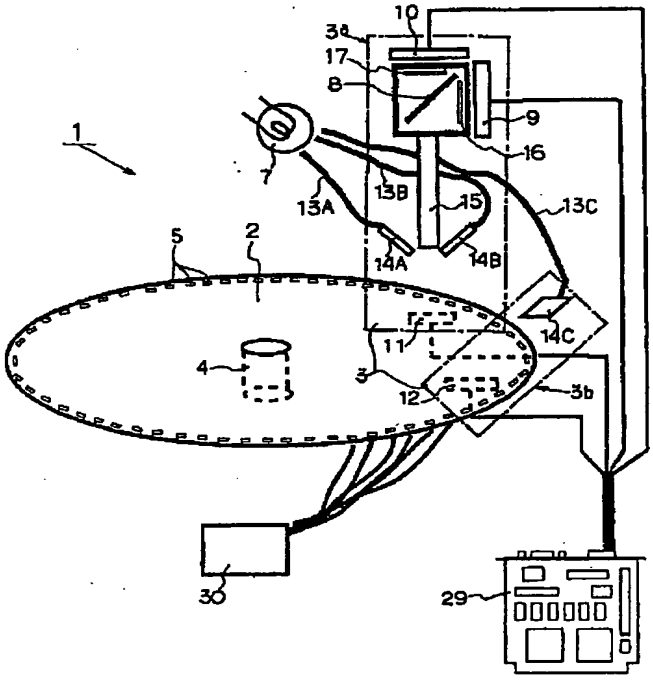
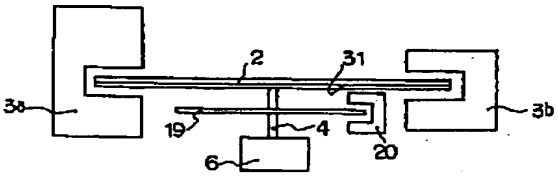
20　位置検出センサー
21　増幅器
22　増幅器
23　増幅器
24　胴割れ波形検出装置
25　増幅器
26　増幅器
27　増幅器
28　A／Dコンバータ
29　CPU
30　選別装置
31　透明部材
32　黒色スリット
33　黒色スリット

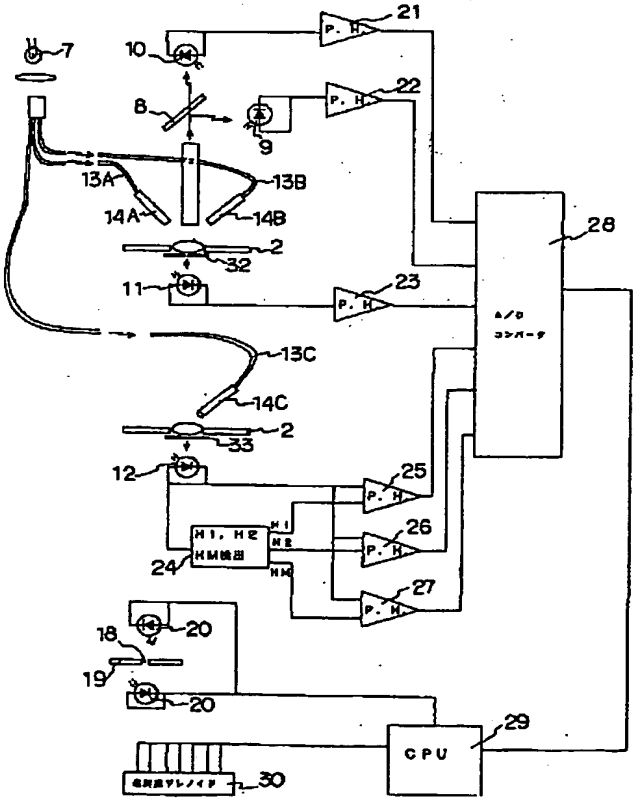
【図1】



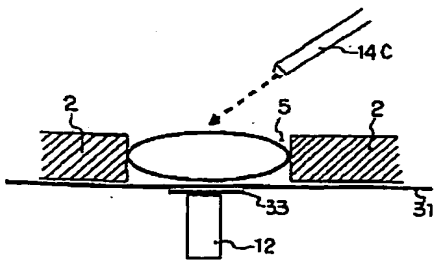
【図2】



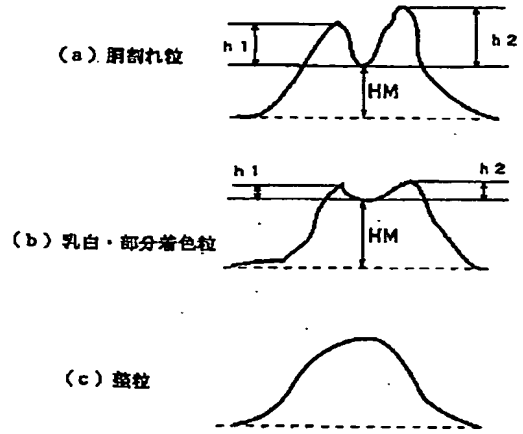
【図3】



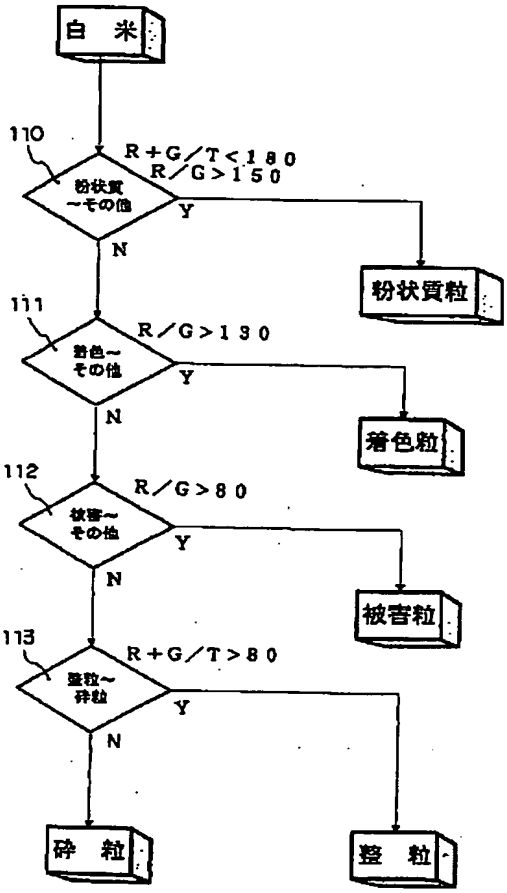
【図5】



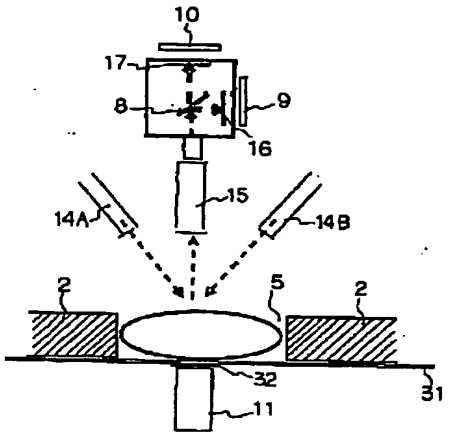
【図8】


(a) 胴割れ粒
h1
h2
HM
h1
h2
(b) 乳白・部分着色粒
HM
(c) 整粒

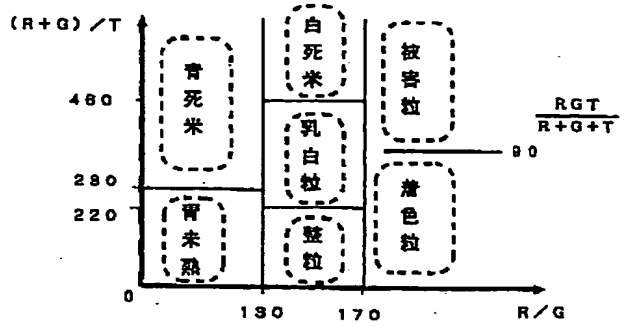
【図9】


白　米
110
R＋G／T＜180
R／G＞150
粉状質～その他
Y
N
粉状質粒
111
R／G＞130
着色～その他
Y
N
着色粒
112
R／G＞80
被害～その他
Y
N
被害粒
113
R＋G／T＞80
整粒～砕粒
Y
N
砕　粒
整　粒

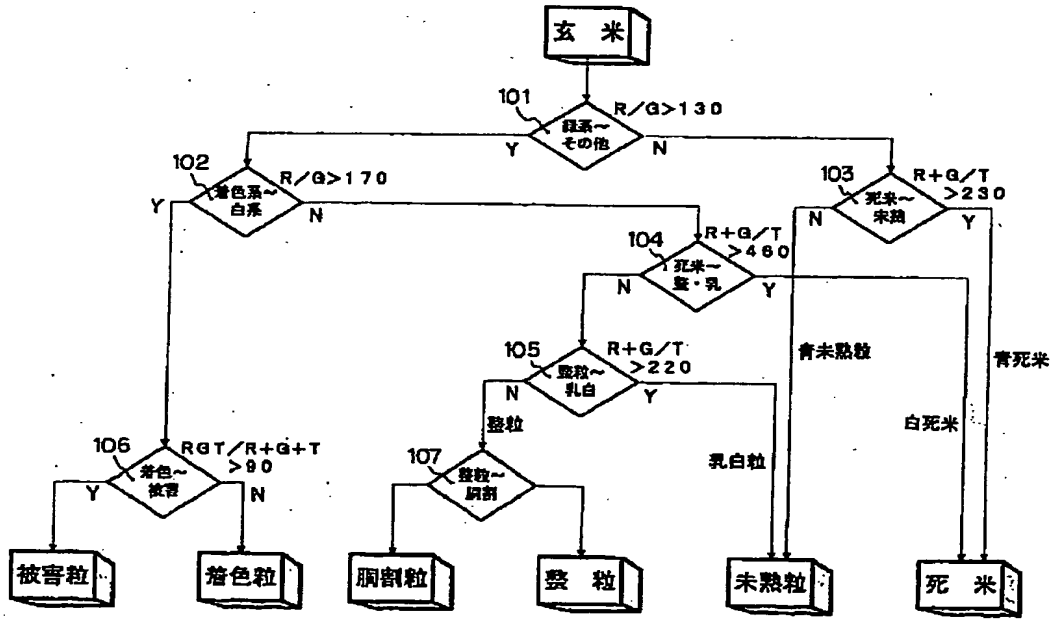
【図4】


10
17
8
9
16
15
14A
14B
2
5
2
32
31
11

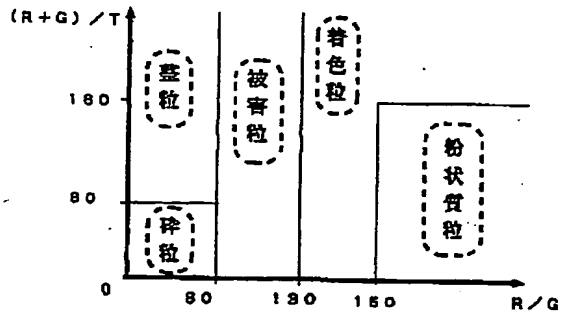
【図7】


(R+G)／T
460
280
220
0
青死米
白死米
乳白粒
整粒
青未熟
被害粒
着色粒
RGT／R+G+T
90
130
170
R／G

【図6】


玄米
101
R／G>130
緑系～その他
Y
N
102
R／G>170
着色系～白系
103
R+G／T >230
死米～未熟
104
R+G／T >460
死米～整・乳
105
R+G／T >220
整粒～乳白
106
RGT／R+G+T >90
着色～被害
107
整粒～胴割
青未熟粒
白死米
乳白粒
整粒
被害粒
着色粒
胴割粒
整粒
未熟粒
死米
青死米

【図10】


(R+G)／T
180
80
0
整粒
砕粒
被害粒
着色粒
粉状質粒
80
130
150
R／G